GREAT LAKES ICEBREAKING CAPABILITY REPLACEMENT

MISSION NEED STATEMENT

22 AUGUST 1997

Submitted By: _____
Assistant Commandant for Operations

Endorsed By: _____
Vice Commandant

Executive Summary

The Coast Guard has prepared this report to define icebreaking and other related mission requirements for the Great Lakes region. This report assesses mission requirements, revalidates the need to continue the mission, defines levels at which the mission will be accomplished against performance standards and customer needs, and assesses the adequacy of Coast Guard capabilities available to accomplish the mission.

Icebreaking mission requirements in this report are assessed primarily on the Coast Guard's federal mandate to, "keep open to navigation by means of icebreaking operations ... channels and harbors within the reasonable demands of commerce."

Part I

Part I of the mission analysis demonstrates that the Coast Guard will not be able to satisfactorily carry out its domestic icebreaking mission on the Great Lakes unless appropriate Coast Guard heavy icebreaking capabilities, currently provided exclusively by CGC *Mackinaw,* are preserved or replaced.

CGC *Mackinaw*, commissioned in 1944, is in the twilight of its useful service life. *Mackinaw*'s WWII era systems and single mission character make it an expensive and inefficient resource. The costs of assuring *Mackinaw*'s mission readiness are escalating and cannot be sustained indefinitely. This sole capable asset approach to Great Lakes heavy icebreaking has always left Great Lakes winter shipping somewhat vulnerable to mission failure and has restricted the Coast Guard's ability to deal with more than one heavy icebreaking problem at a time.

Current plans to replace three 180' WLBs with two 225' WLBs circa 2002 would further reduce Great Lakes icebreaking capabilities.

The Coast Guard's domestic icebreaking mandate remains valid and well aligned with national strategic objectives. The long term forecast of Great Lakes demand for Coast Guard icebreaking services is stable, at or slightly above the current level.

Industry customers have accepted and agreed that new Coast Guard Great Lakes domestic icebreaking mission performance standards satisfy "the reasonable demands of commerce" as our mandate requires.

CGC *Mackinaw*, five WTGBs, three 180' WLBs, and Canadian partnering assets have provided adequate performance against the standards. A "stay the course" fleet consisting of an increasingly unreliable and expensive *Mackinaw,* five WTGBs, two 225' WLBs, and reduced Canadian partnering assets will fail icebreaking mission performance standards.

The costs of inadequate performance are real and substantial. Previous studies found Coast Guard Great Lakes total icebreaking services to have an estimated average annual outcome value of $49-78M to industry alone. The Volpe study estimated the average annual outcome value of *heavy icebreaking* is at least $13-20M. These estimates are based on direct industry costs of least cost alternatives; they do not include any estimates of the consequences of higher costs in a highly competitive global market or the downstream impact in jobs or the larger economy. The Great Lakes iron ore, steel and freight transportation industries alone constitute a considerable economic force within the United States employing 485,000 to 525,000 persons with an annual payroll in excess of $6.7 billion.

Non-material alternatives explored included shortening the winter shipping season, leasing a Canadian icebreaker, or paying for commercial icebreaking; none are acceptable as long term solutions.

Part II

Part II presents several alternatives to meet the future icebreaking resource gaps projected for the Great Lakes. In addition to traditional modernization/replacement of the existing heavy icebreaking asset, there is an opportunity to explore the feasibility of a multi-mission icebreaking buoy tender. Building heavy icebreaking capable tenders takes advantage of the opportunity to develop a resource mix to effectively and economically satisfy both Great Lakes icebreaking and aids to navigation mission performance requirements rather than continuing on a course that develops independent single/focused mission solutions. *Canada has proven the concept with CCGS Risley operations on the Lakes for more than twelve years.*

Preliminary analysis indicates the multi-mission approach warrants further exploration and evaluation along with other heavy icebreaker modernization/replacement options. Icebreaking capability requirements (deep draft) and aids to navigation limitations (shallow draft) may conflict and require a compromise or trade-off among single asset capabilities.

The Great Lakes Icebreaking MAR Parts I and II provide a compelling basis to establish a major systems acquisition project and to proceed with the mission needs statement. Preliminary estimates indicate a lead ship replacement or modernization will cost $93-$130 million.

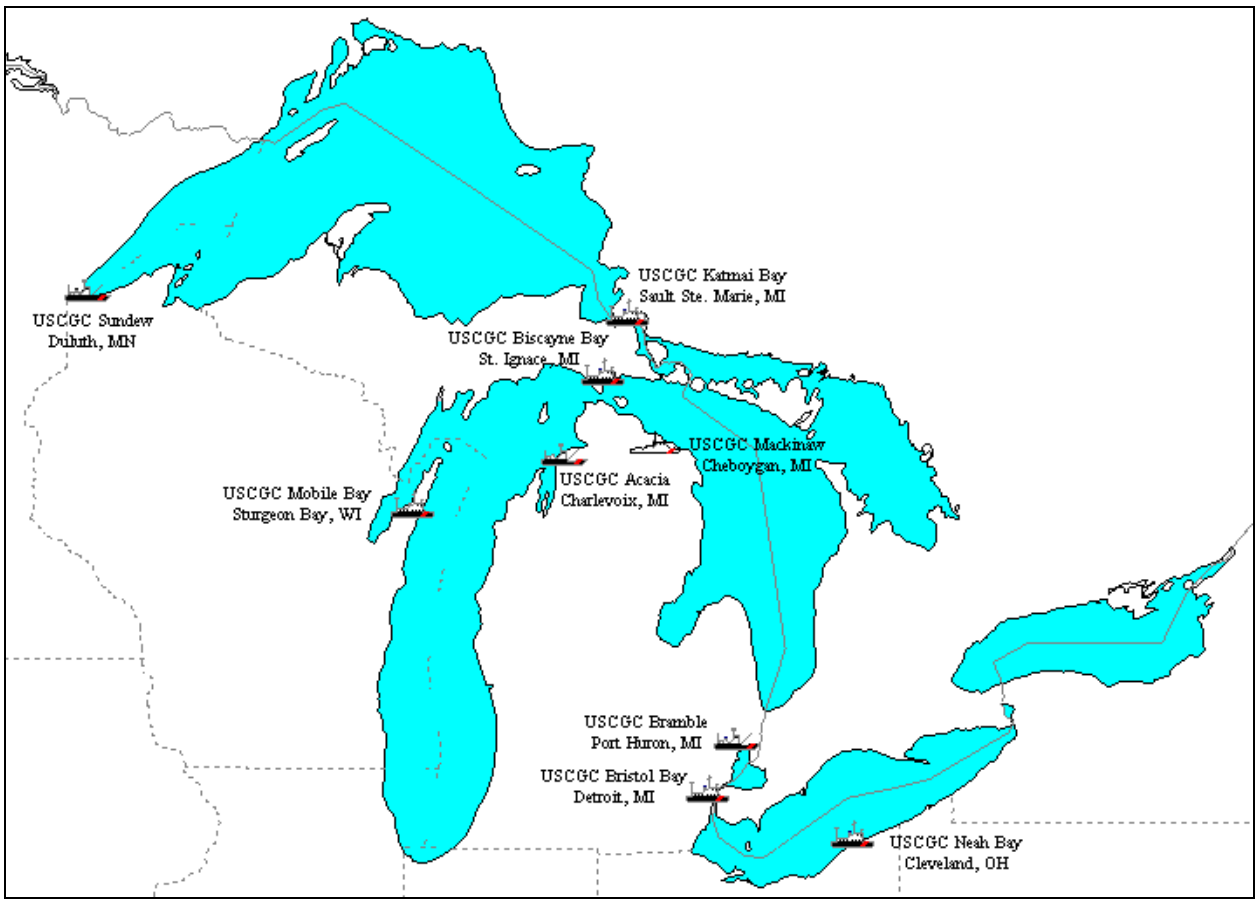
Weekly Timeline

Specific weeks of the season are referred to throughout this report. The following is a chart which pairs dates with their respective week numbers. All charts and tables in the report correspond to this weekly timeline.

Week	1 16OCT-22OCT	2 23OCT-29OCT	3 30OCT-5NOV	4 6NOV-12NOV	5 13NOV-19NOV
Week	6 20NOV-26NOV	7 27NOV-3DEC	8 4DEC-10DEC	9 11DEC-17DEC	10 18DEC-24DEC
Week	11 25DEC-31DEC	12 1JAN-7JAN	13 8JAN-14JAN	14 15JAN-21JAN	15 22JAN-28JAN
Week	16 29JAN-3FEB	17 5FEB-10FEB	18 12FEB-17FEB	19 19FEB-24FEB	20 26FEB-3MAR
Week	21 4MAR-10MAR	22 11MAR-17MAR	23 18MAR-24MAR	24 25MAR-31MAR	25 1APR-7APR
Week	26 8APR-14APR	27 15APR-21APR	28 22APR-28APR	29 29APR-5MAY	30 6MAY-12MAY
Week	31 13MAY-19MAY	32 20MAY-26MAY	33 27MAY-2JUN	34 3JUN-10JUN	

Seasons by week:

Fall ATON Decommissioning Season……..... Weeks 1 - 10
Winter Ice Season……..... Weeks 9 - 28
Spring ATON Commissioning Season……..... Weeks 25 - 33
Sault Ste. Marie Lock Closure……..... Weeks 14 - 23



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1. DESCRIPTION OF THE MISSION

1.a Required Mission

The Coast Guard conducts icebreaking activities during the winter months to facilitate maritime commerce and to prevent loss of life, personal injury, and property damage on the navigable waters of the Great Lakes. The Coast Guard's strategic goals to improve mobility and safety are linked to the four primary goals of domestic icebreaking activities:

- Extricate vessels and personnel from danger caused by ice.
- Prevent damage due to flooding caused by ice dams.
- Maintain the navigation season in ice bound areas where cost/benefit analysis and environmental impact studies indicate such services are in the Nation's interest.
- Minimize delays to commerce on navigable waters caused by ice and navigation hazards.

1.b Mission Needs

Mission needs for Great Lakes icebreaking are based on the federal mandate to meet the reasonable demands of commerce during the winter shipping season. In general, the Coast Guard is required to establish and maintain tracks in navigable waters, provide escort and direct assistance to mariners, and relieve ice jams which cause flooding. Specific requirements include:

- Establish and maintain tracks in ice covered navigable waters.
- Escort commercial vessels when ice impedes the economical movement of goods and people.
- Assist/free vessels beset in ice.
- Recover personnel from ice covered waters and provide emergency medical assistance.
- Recover, remove, or relocate discrepant AtoN and other hazards in ice covered waters.
- Transport passengers of Island communities when ferry service is impeded by ice.
- Relieve ice jams in restricted waterways.

1.c. Authority

The Coast Guard operates under numerous federal mandates with regard to Great Lakes icebreaking mission requirements. Those mandates include:

Executive Order No 7521, dated 21 December 1936 "The Coast Guard shall assist in keeping open to navigation by means of icebreaking operations ... channels and harbors within the reasonable demands of commerce."

14 USC 2 "The Coast Guard shall ... develop, maintain, establish and operate icebreaking facilities and aids to navigation for the promotion of safety on and over the high seas and waters subject to the jurisdiction of the United States."

14 USC 88 "The Coast Guard shall aid persons or vessels in distress on the high seas or on waters which the United States has jurisdiction." Distress may be caused by, among other things, vessels beset in ice or regions imperiled by flooding due to ice.

14 USC 141 "The Coast Guard may, when so requested by proper authority, utilize its personnel and facilities to assist, among others, Federal and State agencies." Under this authority, the Coast Guard conducts icebreaking in channels and harbors to relieve flooding conditions.

2. RATIONALE FOR THE ACQUISITION

2.a Current Capability

The Coast Guard employs nine major cutters for icebreaking on the Great Lakes: The 290' *Mackinaw* (WAGB), five 140' icebreaking tugs (WTGB), and three 180' buoy tenders (WLB). Five of these icebreaking assets (three WLBs and two WTGBs with barges) are also employed to service aids to navigation immediately prior to and following the icebreaking season. An inventory of operating characteristics and normal operating season for these assets is provided in the following table:

Vessel Class	Effective Ice Capability			Length (ft)	Beam (ft)	Draft (ft)	Horse-Power	Operating Season
	Plate	Brash	Ridges					
WAGB (1)	36 in	9-12 ft	12-15 ft	290	74	19	10000	12/15-4/15
WTGB (5)	22 in	4-6 ft	6-9 ft	140	37	12	2500	12/15-4/15 10/16-6/1*
WLB (3)	14 in	2-4 ft	4-6 ft	180	37	13	1200**	10/16-1/15 3/18-6/1

* WTGBs with barges

** Sundew 1650 horsepower

Coast Guard cutters work in close coordination with three Canadian Coast Guard Ships to provide a diverse mix of operational capability necessary to meet the following Coast Guard mission goals and performance standards for Great Lakes icebreaking:

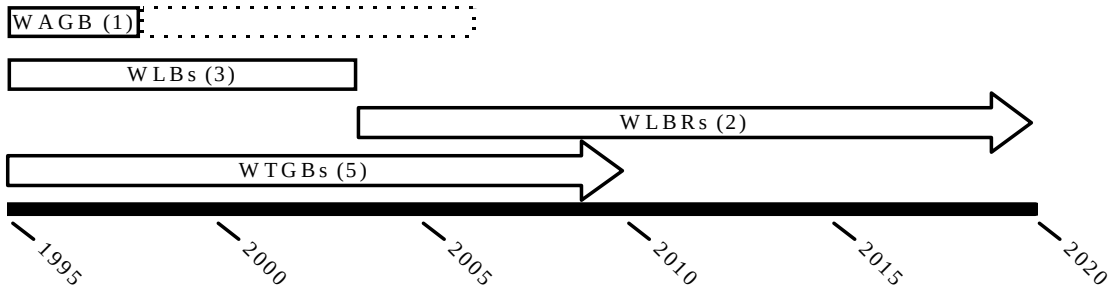
- **Extricate vessels and personnel from danger caused by ice:** Respond to requests from people or vessels beset or stranded in ice within 2 hours of notification. Arrive on scene to assist within 6 hours of notification or first light if risk assessment determines delay beyond 6 hours is acceptable.

- **Prevent damage due to flooding caused by ice:** Relieve ice jams at the request of the U. S. ACOE prior to water levels exceeding flood stage with a minimum notification of 24 hours.

- **Maintain the navigation season in ice bound areas where cost/benefit analysis and environmental impact studies indicate such services are in the Nation's interest.** Provide icebreaking to facilitate winter shipping in critical waterways of the Great Lakes. Limit waterway closures due to ice to not more than 2-8 days depending on winter severity.

- **Minimize delays to commerce caused by ice and navigation hazards:** Provide icebreaking services to the level necessary to enable commerce to transit in ice covered waters at 3 knots or better, 70-90 percent of the time, depending on winter severity.

Mackinaw is the only heavy icebreaking capable asset assigned to the Great Lakes and has completed 53 years of service; there are no existing plans for a heavy icebreaker replacement. The reliability and readiness of *Mackinaw* will become a risk and unacceptable cost to mission performance by 1998. Major maintenance, expected to cost $3.5 million over three years, is required as a short term option to extend *Mackinaw*'s service life to 2006. The three aging WLBs have also served more than 50 years and are scheduled for replacement and fleet reduction by 2003. *Mackinaw* and the three WLBs have all previously undergone service life extensions. A projected **reduced icebreaking fleet** expected by the year 2006 will consist of seven cutters including five 140' WTGBs and two 225' WLBRs, as shown below.



2.b Planned Capability

There are no expected changes in the statutes and regulations that govern icebreaking on the Great Lakes. Previously stated icebreaking performance standards remain valid. While seasonal demands for icebreaking vary significantly due to the severity of winter ice conditions, historical trends indicate shipping demand will remain strong and require the current 42 week shipping season. Year round shipping in the lower lakes remains necessary to deliver critical cargo and raw materials to Great Lakes ports.

The *Mission Analysis Report* indicates a reduced icebreaking fleet will not have the **heavy icebreaking capability** necessary to meet minimum icebreaking performance standards. The future fleet must continue to provide a diverse mix of operational capabilities that are both adequate and available to meet the icebreaking demands on the Great Lakes. Planned capabilities are defined as follows:

Heavy Icebreaking Capability Heavy icebreaking functional requirements are defined in *Appendix E* of the *Mission Analysis Report.* In general, the planned capability must be able to establish and maintain tracks in navigable waters, provide escort and direct assistance to mariners, and relieve ice jams during severe ice conditions when very thick plate ice, brash ice, and pressure ridges are present. Severe ice conditions demand heavy icebreaking capabilities be available for a minimum of the first three weeks in January and for another five weeks in late March and early April.

Resource Availability Icebreaking demands will exceed the resource availability of the reduced icebreaking fleet. Planned assets should close the resource gap identified in *Appendix D* of the *Mission Analysis Report.*

Surge Capacity Operating assets are frequently exposed to hazardous conditions while employed for icebreaking and aids to navigation duties. The temporary loss of one or more assets, while not planned, should be expected. Surge capacity (system redundancy) remains critical to overall mission success and should weigh heavily in future asset selection and fleet mix decisions.

2.c Proposed Alternatives

Several alternatives are available to meet the planned heavy icebreaking capabilities for the Great Lakes. Options recommended for further exploration and feasibility studies include:

Retrofit *Mackinaw* with crew reductions: Retrofit *Mackinaw* to extend its service life 20 years, and reduce the current crew complement of 75 people. *Mackinaw* would meet or exceed all heavy icebreaking requirements and remain primarily a single mission icebreaking asset. The vessel would be taken out of service for a minimum of one icebreaking season to perform retrofit.

Heavy Icebreaker Replacement: Design and build a heavy icebreaker replacement similar in size and capability to the *Mackinaw*. The vessel would meet all heavy icebreaking requirements and be designed as primarily a single mission icebreaking asset.

Heavy Icebreaking Buoy Tender Replacement: Design and build a fleet mix of icebreaking buoy tenders to replace *Mackinaw* and three WLBs. The vessels would be designed to meet both heavy icebreaking and aids to navigation requirements on the Great Lakes.

2.d Project Risks

Performance Risk associated with the heavy icebreaker replacement option is low assuming the use of proven technology. There is moderate risk associated with the modernization option due to the continued operation of original equipment (many original systems will not be renewed) and structural constraints which may not allow for proper design, configuration, and installation of new systems and/or technologies. Performance risk associated with the multi-mission icebreaking buoy tender option is also moderate unless proven technology is available.

Cost Risk associated with all options is low; however, there will be competing interests for limited acquisition funds as our deep water assets come up for replacement. The potential for cost growth is greater for the modernization option due to the high probability of change orders resulting from unknown conditions likely to be found during construction.

Schedule Risk associated with all options is moderate to high due to an aggressive schedule to deliver replacement capabilities prior to 2006. There is also significant external interest to further accelerate the project schedule.

Mackinaw Availability The option to modernize *Mackinaw* may interrupt the Coast Guard's ability to provide heavy icebreaking capabilities when the vessel is removed from service for renovation and modernization. The Canadian Coast Guard currently has excess heavy icebreaking capability that is available for lease on a seasonal and short-term basis.

2.e Acquisition Strategy Objectives

The acquisition strategy will be to fulfill mission needs as soon as possible using non-developmental technology. The Coast Guard will continue to partner with Great Lakes industry and primary stakeholders to develop heavy icebreaking operating requirements. Replacement assets will be assessed individually and then as a combined system to maximize overall mission effectiveness and optimize life cycle costs. Final resource selection will be made on the basis of overall value.

3. IMPACT OF DISAPPROVING THE ACQUISITION

3.a Existing Capability and Resources

CGC *Mackinaw*, commissioned in 1944, is in the twilight of its useful service life. *Mackinaw*'s WWII era systems and single mission character make it an expensive and inefficient resource. *Mackinaw* has exceeded its useful service life, maintenance costs are increasing, and operational readiness is at risk. Mission performance will suffer and operating expenses will become cost prohibitive without a service life extension and modernization project. Approximately $3.5 million in funding, above the current annual support level of $800,000, is required to keep *Mackinaw* in service beyond 1998. Current plans to replace three 180' WLBs with two 225' WLBRs will further reduce Great Lakes icebreaking capabilities.

Icebreaking mission performance relies heavily on both adequate heavy icebreaking capability and available icebreaking capacity. A **reduced icebreaking fleet** comprised of five WTGBs and two WLBRs will fall short on both accounts:

- The WTGB vessel (working alone or in tandem) does not meet heavy icebreaking requirements for the Great Lakes;

- The ice strengthened *Juniper* class buoy tender (working alone or in tandem) does not meet the heavy icebreaking requirements for the Great Lakes. While the new buoy tender can exceed its designed icebreaking capability in plate ice, the vessel does not have the maneuvering capability to back in plate ice exceeding 12 inches. Current plans to replace three 180' WLBs with two 225' WLBRs will further degrade the availability and surge capacity of the icebreaking fleet.

A "stay the course" fleet consisting of an increasingly unreliable and expensive *Mackinaw*, five WTGBs, two WLBRs, and reduced Canadian partnering assets will fail icebreaking mission performance standards. Without adequate heavy icebreaking capabilities, industry will experience a winter shipping season shortened by at least five weeks; a five week closure will reduce total shipments on the Great Lakes by approximately 10 percent or 15 million tons of raw materials. The Coast Guard's ability to respond to infrequent but critical flood conditions will also be significantly diminished.

The costs of inadequate performance are real and substantial. As stated in the *Mission Analysis Report*, Coast Guard Great Lakes icebreaking services provide an estimated average annual benefit of $49-78 million to industry alone. This benefit represents the avoided costs of transportation alternatives that would be necessary in the absence of icebreaking services. The estimated annual benefit of heavy icebreaking is at least $13-20 million. These estimates are based on direct industry costs of the least cost alternative; they do not include any estimates of the consequences of higher costs in a highly competitive global market or the downstream impact in jobs or the larger economy.

The iron ore, steel and freight transportation industries tied to Great Lakes shipping constitute a considerable economic force within the United States directly employing approximately 161,000 persons with an annual payroll in excess of $6.7 billion. The total direct and indirect employment resulting from these industries is estimated at 485,000 to 525,000 persons.

3.b Project Constraints

Shipyard Availability *Mackinaw* was built to operate in a fresh water environment which may confine the retrofit option to shipyards within the Great Lakes region. Shipyard availability for other options may also be limited if the overall size and displacement of a replacement vessel exceeds the maximum physical dimensions for vessels transiting the St. Lawrence Seaway.

Schedule A planned delivery date of 2006 will require an accelerated acquisition schedule.

3.c Potential Opportunities

Improved performance at lower costs Replacing or modernizing aging assets should provide opportunities to improve performance and availability while reducing operating and maintenance costs.

Multi-mission Seeking multi-mission assets provides the opportunity to develop a resource mix to effectively and economically satisfy both Great Lakes icebreaking and aids to navigation mission performance requirements rather than continuing on a course that develops independent single/focused mission solutions. Designing future assets to meet both icebreaking and aids to navigation mission requirements will extend the annual employment opportunity, improve the depth and robustness of the cutter fleet, and offer opportunities to reduce the overall fleet size without sacrificing mission responsiveness or surge capability.

4. RESOURCES REQUIRED

4.a Total Acquisition Cost

The preliminary acquisition cost for a heavy icebreaker modernization or replacement capability is estimated to be $93-$130 million, in FY97 dollars. A more complete total acquisition cost estimate will be made at KDP-2 after conducting concept exploration studies and identifying a total system solution.

4.b Timing

A heavy icebreaker replacement or service life extension of *Mackinaw* is required by 2006. To ensure a continued heavy icebreaking capability on the Great Lakes, the Coast Guard has developed a short term strategy to keep *Mackinaw* in operation until 2006 at an additional cost of $3.5 million above its current annual support level of $800,000.

4.c Priority/Affordability

Priority The Coast Guard's domestic icebreaking mandate remains valid and well aligned with national strategic objectives. In addition to the statutory authority which requires domestic icebreaking services, there is a growing national interest to facilitate commerce to improve the nation's economic standing in the competing global market. The Coast Guard's first priority should be to assure the continued presence of a suitable and reliable heavy icebreaking capability for the Great Lakes.

Secondarily, the Coast Guard should seek to close the icebreaking capacity gap identified in the *Mission Analysis Report*.

Affordability Projected funding for a heavy icebreaking capability replacement or service life extension is included in the long range resource allocation plan and is outlined in both the FY98 Capital Investment Plan and the proposed 1999 Agency Capital Plan.

4.d Other Government Agencies

In addition to federal statutory requirements, the United States and Canadian Coast Guards operate under a cooperative international agreement to best meet icebreaking demands on the Great Lakes. Both agencies continue to coordinate resource employment and icebreaking responsibilities to improve overall mission performance while minimizing operating costs.

5. RECOMMENDATIONS

Approve the Mission Need Statement for the *Great Lakes Icebreaking Capability Replacement Project*; designate the project as a level III major acquisition; and grant permission to proceed under the oversight of the Administration Acquisition Executive.